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REPORT OF
Thirty-Second Annual
DATE GROWERS' INSTITUTE

April 23, 1955



HELD IN
COACHELLA VALLEY
CALIFORNIA

THIRTY-SECOND ANNUAL DATE GROWERS' INSTITUTE

HELD IN
COACHELLA VALLEY

APRIL 23, 1955

VOLUME 32

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Grower

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Roy W. Nixon
U. S. Date Garden, Indio

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Volume 32

Published by the

DATE GROWERS' INSTITUTE

Coachella Valley, California

October 1, 1955

The Date Growers' Institute is the official educational instrument of the date industry. Its goal is the dissemination of information on date growing, handling and marketing. This is its thirty-second year. Proceedings of each Institute have been published, and may be purchased in complete sets, or by separate copies. A full Index will be mailed on request. Direct all inquiries to the Secretary.

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GROWTH AND YIELD OF KHADRAWY DATE PALMS IRRIGATED AT DIFFERENT INTERVALS FOR TWO YEARS

By J. R. Furr and W. W. Armstrong

U. S. Dept. of Agriculture, Indio, California

In discussions of the irrigation of dates, writers have often quoted the old Arab proverb which in one form says, "The date palm, queen of trees, must have her feet in running water and her head in the burning sky" (10). This saying obviously implies that it is advisable to keep the soil moisture in date gardens at a very high level. Several investigations (1, 2, 8) have shown that prolonged periods of severe water shortage during the growing season had ill effects on the growth of leaves and on size, grade and yield of fruit. More recent tests on the effects of water supply during the period of ripening and harvest indicated that at this time dates may be subjected to considerable variation in soil-moisture conditions without a significant effect on fruit quality or yield (4, 5). None of these experiments, however, showed what effects on growth and yield could be expected from repeated fluctuations in the soil moisture between field capacity and different levels above the wilting point of the soil in the principal root zone — such fluctuations as would be brought about by variation in time between applications of irrigation water. The experiment described in this paper was conducted to obtain information on this question.

DESCRIPTION OF EXPERIMENT AND MATERIALS

Four irrigation treatments were applied in a block of 18-year-old Khadrawy palms. The treatments consisted of variations in time interval between applications of water as follows: 2, 4, 8 and 16 weeks, and were maintained for 2 years, 1953 and 1954, except for an increase in interval during harvest in 1954. In each treatment there were 4 plots of 2 test trees surrounded by border trees. The rows were separated by raised borders that permitted the application of water over the surface of each plot. Because half of the plots were on the lower halves of the irrigation runs, it was not possible to apply equal amounts of water to all, but an effort was made to re-wet all the soil in the root zone of each treatment at the end of its drying cycle. With this object in view, when the different treatments were irrigated the borders of the 2-week plots were filled once and those of the 4-, 8- and 16-week plots were filled 2, 4, and 8 times, respectively. The amount of water applied to individual plots was not measured, but, depending upon how dry the soil was, probably amounted

to 3 to 5 inches each time the borders were filled. The average amount of water applied to all the plots in 1953 was 9.1 acre-feet and in 1954 was 8.7 acre-feet. Since the borders were filled only once in a day and it was usually not convenient to irrigate each day, it sometimes took 2 weeks to irrigate the 16-week plots. Except in a few instances when well water was used, the irrigation water was Colorado River water from the Coachella Valley Branch of the All American Canal.

The soil is classed as Indio very fine sandy loam and, since it is of recent origin and was deposited by water and wind, is sharply stratified. The approximate amount of available water that can be held in the top 7 feet of the soil is shown by the following values, which were calculated from the average moisture percentages of the soil in the four 16-week plots at field capacity and at the wilting point:

1st foot—	2.4 acre inches
2nd foot—	3.3 acre inches
3rd foot—	3.4 acre inches
4th foot—	3.7 acre inches
5th foot—	3.3 acre inches
6th foot—	2.5 acre inches
7th foot—	1.3 acre inches
Total—	19.9 acre inches

Soil-moisture changes were observed in the 8-week and 16-week treatments by taking soil samples several times during each drying cycle, and in all treatments by reading the electrical resistance of gypsum blocks installed at various depths to as much as 15 feet in the 16-week treatment. The wilting point of the soil at a given depth was assumed to be the moisture percentage at which the soil-moisture curve became almost flat. These curves were plotted separately for each plot sampled but are not shown. The growth rate of the leaves was obtained from periodic reading of a measuring tape attached to a young leaf. As the leaf elongated, the tape was pulled past the head of a nail driven into the tree trunk (3).

Yields were determined as the harvest-weight of picked fruit, not including field culls. Samples of fruit were taken from each tree at most picks for determination of average weight per fruit and average weight per seed. All the unbroken and otherwise sound inflorescences that could be retained on the test trees were pollinated and allowed to mature fruit, so as to obtain the maximum yields possible from them. In the summer of 1954, root samples were taken in the 16-week plots by boring

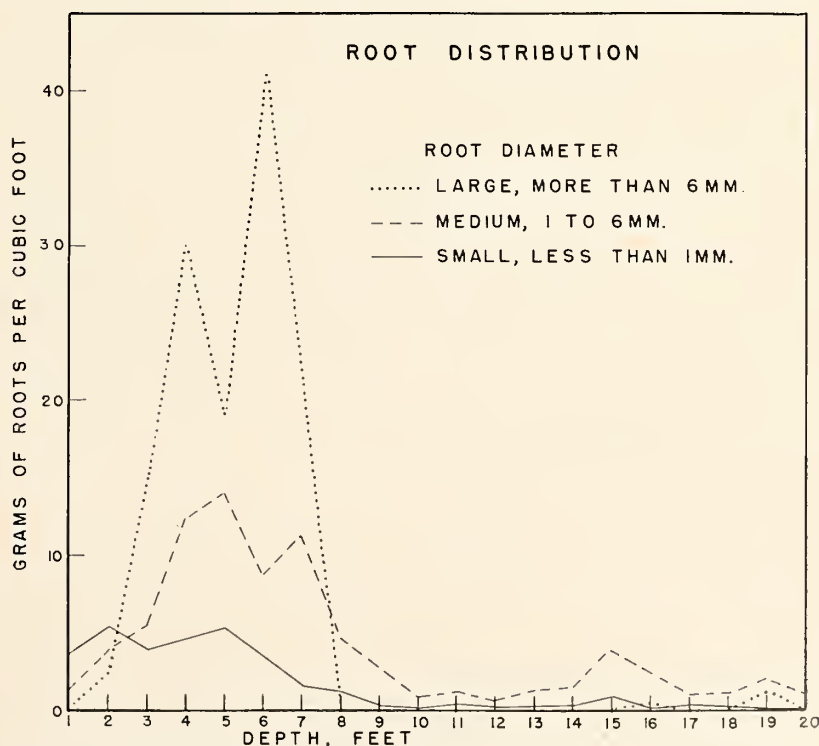


Figure 1—Distribution of palm roots of various sizes 15 feet from trunks in plots irrigated at 16-week intervals.

holes with an auger to a depth of 20 feet and screening the soil to remove the roots. On each plot one hole was bored at 5 feet and three holes at 15 feet from the tree trunk.

RESULTS

The response of the trees to the irrigation treatments described cannot be readily understood without some knowledge of the root distribution of the trees. The concentration of large, medium-sized, and small roots at 1-foot intervals to a depth of 20 feet is shown graphically in Figure 1. The curves represent the average concentration 15 feet from the trunks in the four 16-week plots. The relative concentration at the various depths 5 feet from the trunks was remarkably similar to that at 15 feet from the trunks, but the actual concentration per cubic foot was nearly three times as great. The distribution at 15 feet from the trunk is shown because it probably repre-

sents best the average condition in the root zone and in the situation from which soil samples were taken for moisture determinations. The concentration of roots was closely related to the texture of the soil at the different depths, being highest in the silty layers and very low in layers of nearly pure sand. This effect of soil texture accounts in part for the high concentration of feeder roots in the top 5 feet, the gradual decrease from 5 to 9 feet and the low concentration from 9 to 20 feet depth. The differences in concentration at various depths in single bore holes were striking. In general, the soil below 7 feet was sand nearly free from silt and clay, but even at 15 feet or more where there was a silty layer the feeder-root concentration increased sharply. In fact, below 10 feet there were few feeder roots except in the silty strata.

Curves representing the average leaf-growth rates of trees in all treat-

ments in 1953 and the average soil-moisture percentage of various layers of soil in the top 7 feet of the 8-week and the 16-week treatments in 1953 are shown in Figure 2. Though soil samples were taken at foot intervals, for simplification in plotting the results, the moisture percentages of samples from soil depths of similar water-holding capacity were averaged. For example, one curve representing the average moisture percentage of the 2nd, 3rd and 4th feet is shown. The soil was not sampled in the 2-week and 4-week treatments, but resistance readings of gypsum blocks at depths of 2 to 8 feet showed that the moisture content of the soil in these treatments remained relatively high all year. In these treatments in 1953 the resistances did not exceed 700 ohms, which represents a moisture content near field capacity.

The curves representing leaf growth show that in 1953 differences in soil moisture apparently had little or no effect on growth in any of the treatments during the first drying cycle of the 16-week treatment (Feb. 19 to June 10), but that in the second drying cycle of this treatment (June 16 to Oct. 1) the leaf-growth rate of trees in the 16-week treatment was about 75 or 80 percent of that in the 2-week treatment. At the end of the second drying cycle most of the soil in the top 6 feet of the 16-week plots was in the wilting range.

In 1954, the first drying cycle of the 16-week plots started in early February and the second in early June (Figure 3). Even in the 16-week plots, in which most of the soil in the top 7 feet was not far above the wilting range just before these plots were irrigated in late May, the growth curves show little apparent effect of water shortage on leaf-growth rate.

The second drying cycle of the 16-week plots was scheduled to end Sept. 23, but the application of water would have interfered with harvesting operations; consequently the irrigation of all plots was delayed until November 1. Thus, in the 16-week plots this cycle was prolonged to 5 months, and much of the soil in the top 6 feet was in the wilting range for several weeks. Because of cool weather during September and October, however, the leaf-growth rate in the 16-week plots did not fall below about 80 percent of that in the 2-week plots. Except in the 16-week treatment, it is not readily apparent from the leaf-growth rate curves that growth was affected by water supply in either 1953 or 1954.

The yearly average rates of leaf elongation per day in the several treatments (Table 1) show, however, that while differences in leaf-growth rate in the different treatments were not significant in 1953, the average

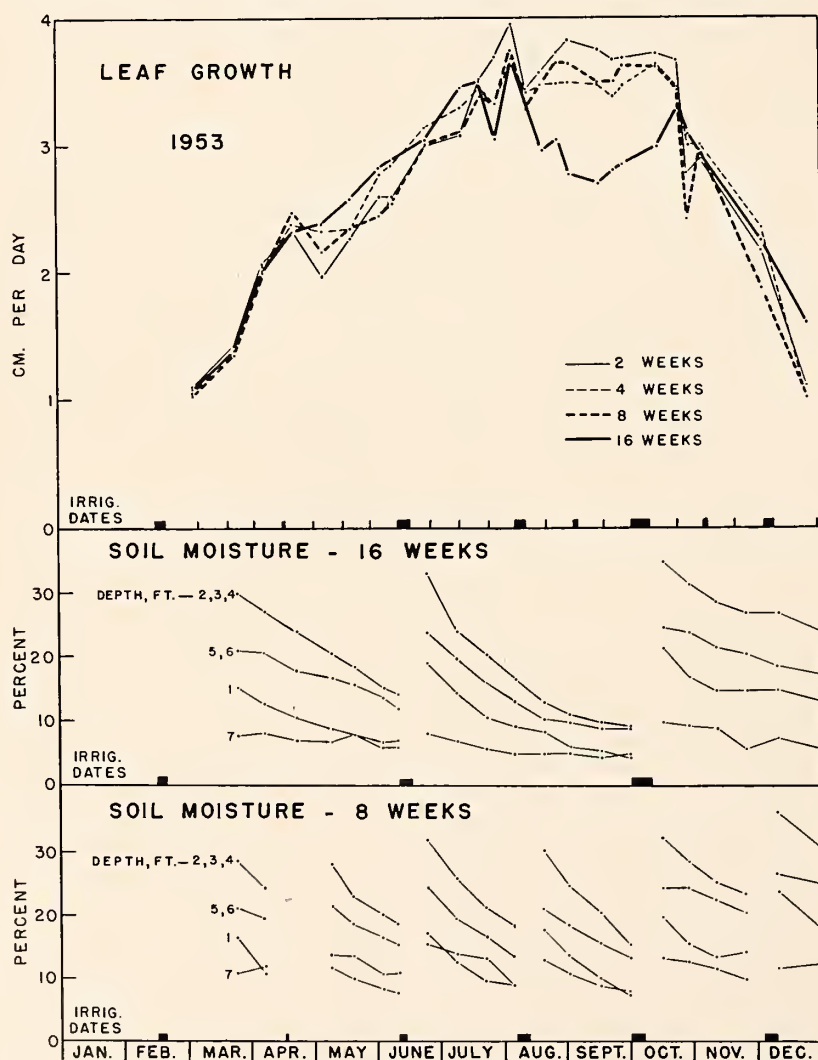


Figure 2—The average daily rate of leaf elongation in each treatment and the average moisture content of the soil in the 8-week and 16-week treatments in 1953. The width of the bars representing irrigation dates indicates the period during which water was applied.

rates of leaf growth in the 2-week and 4-week treatments were significantly greater than in the 16-week treatment in 1954.

As has been stated, the trees were cropped as heavily as possible, so that any effect the irrigation treatments might have on fruiting capacity would be reflected in the yields. The average number of fruit bunches per tree in each treatment that matured fruit in 1953 and 1954 is shown in Table 1. In neither year were the differences significant, and it should be noted that in all except the 2-week treatment the average number of bunches that matured fruit in 1954 was slightly greater than in 1953. It was supposed that the prolonged period of water shortage to which the trees in the 16-week treatment were subjected in September and October, 1954, might delay flowering and reduce the number of inflorescences appearing in the spring of 1955. The average number of bunches per tree pollinated by April 4, 1955, in the different treatments was as follows: 2-week, 9.3; 4-week, 9.5; 8-week, 10.4; 16-week, 8.4. The average number of inflorescences per tree that appeared in the spring of 1955 was as follows: 2-week, 15.4; 4-week, 16.0; 8-week, 16.5; 16-week, 15.3. It was obvious that the drought caused some delay in emergence of inflorescences in the 16-week treatment; it may also have caused some reduction in the average number that emerged, but this is uncertain.

The average yield of fruit per tree in each treatment in 1953 and 1954 is shown in Table 1. Differences in yield in 1953 were not significant, but a statistical analysis of the 1954 yields indicates that the average yield per tree of the 8-week plots was significantly greater than that of the 2-week and 4-week treatments. Why this is so is not clear, though the silty top

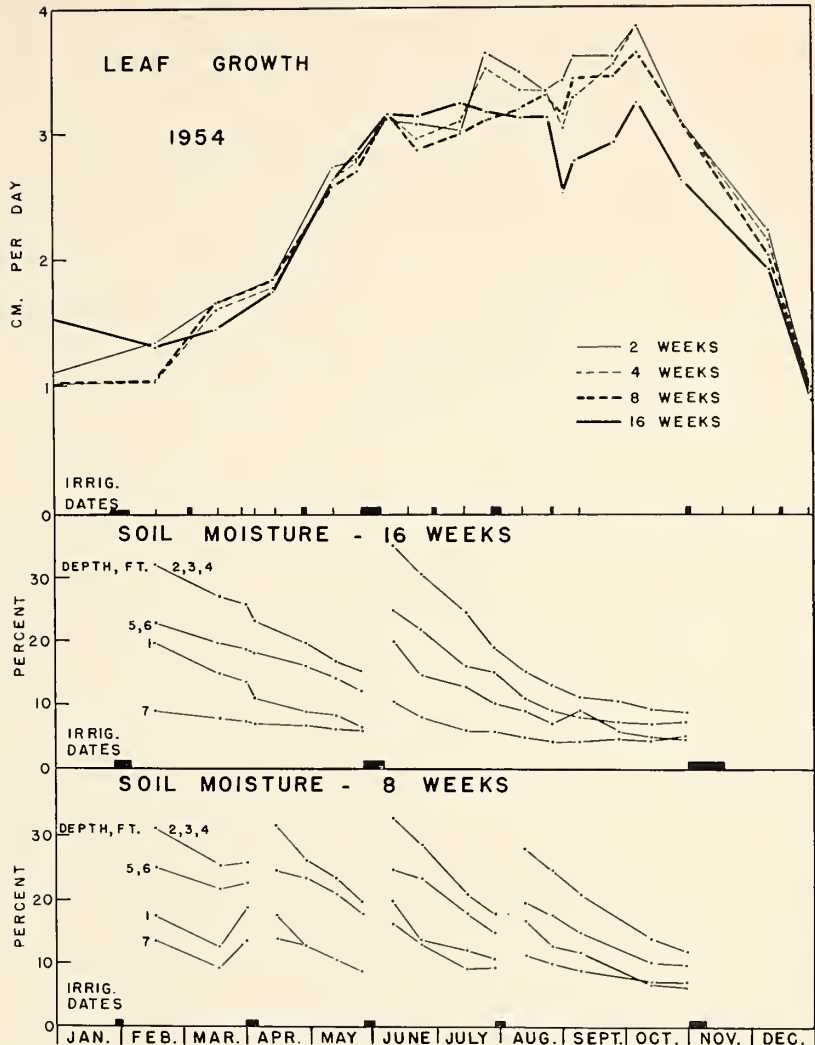


Figure 3—The average daily rate of leaf elongation in each treatment and the average moisture content of the soil in the 8 week and 16-week treatments in 1954. The width of the bars representing irrigation dates indicates the period during which water was applied.

layer of soil is thinner in one plot of the 2-week treatment than in any other in the experiment, and it is possible, but not apparent, that the

soil of the 8-week plots is better than that of the 4-week plots. At any rate, it seems unlikely that the superior yield in the 8-week treatment actually resulted from its being irrigated every 8 weeks rather than every 4 weeks or every 2 weeks.

In Table 1 the average fresh weight per fruit and the average air-dry weight per seed of samples taken in 1953 and 1954 are listed. It appears that there was a slight decrease in fresh weight per fruit with increase in the length of the irrigation interval. The dry weight of the fruit samples was not determined because of the difficulty of drying large numbers of date samples, but the weight of air-dry seed samples was determined as an index of fruit size (7). The average seed weights were nearly the same, and this indicates that the differences in average fresh weight of fruits resulted from differences in moisture content of the fruit pulp at the time of harvest.

Table 1.—Average Leaf Elongation, Production of Bunches, and Yield of Khadrawy Dates Irrigated at Different Intervals, 1953-54.

Year and irrigation interval	Annual average leaf elongation per day	Bunches maturing fruit per tree	Annual yield of fruit per tree	Fresh weight per fruit	Air-dry weight per seed
	cm.	number	pounds	grams	grams
1953					
2-Weeks	2.66	12.5	202	11.37	0.89
4-Weeks	2.56	12.5	205	10.81	0.90
8-Weeks	2.66	12.1	211	10.70	0.88
16-Weeks	2.54	12.6	216	10.35	0.91
Significance	N.S. ¹	N.S. ¹	N.S. ¹	* ²	N.S. ¹
L.S.D. at 5% level				0.15	
1954					
2-Weeks	2.59	12.1	252	11.14	0.87
4-Weeks	2.63	13.3	260	10.95	—
8-Weeks	2.57	14.4	309	10.33	—
16-Weeks	2.45	14.1	287	10.22	0.89
Significance	* ²	N.S. ¹	* ²	* ²	N.S. ¹
L.S.D. at 5% level	0.13		38	0.74	

¹ N.S.=difference between two means is not significant
² * =difference between two means significant by odds of 19:1

DISCUSSION AND CONCLUSIONS

It is clear from the data on both root concentration and changes in soil moisture that the silty soil in the upper 5 to 7 feet must be considered as the principal root zone of the trees used in this study, even though roots extended to a depth of 20 feet or more. This is true, apparently, because most of the soil below the top 5 to 7 feet is fine sand relatively free of silt and clay, and though the large roots grew through the sand, almost no feeder roots were found except in the layers of silt or silty sand that occurred at irregular intervals in the profile. It is apparent that such strata of clean sand are for some reason a poor medium for date roots. A similar response of citrus-root systems to layers of clean sand has been observed (6). Reuther (9) found that dates growing on a soil with the upper 9 feet composed almost entirely of such sand and kept at moisture contents near field capacity were, nevertheless, benefited by the application of a continuous trickle of water amounting to 25 cubic feet a day on each tree. This suggests that at moisture contents below field capacity date roots do not receive a good water supply from sand that contains little silt or clay.

The changes in soil-moisture content in the 16-week plots in the upper 5 or 6 feet of soil, where root concentration was high, indicated that moisture was extracted by the roots in this zone at a nearly uniform rate until about two-thirds of the moisture between field capacity and the wilting percentage was removed, and that then the rate of extraction gradually decreased. It was during this period of decreasing extraction rate in the principal root zone that the leaf-growth rate was reduced appreciably and it seems likely that any acceleration of moisture absorption by roots in moist soil below the top 6 feet after the soil in the principal root zone reached the wilting range did not compensate for the lowered rate of absorption in the principal root zone.

The main purpose of this investigation was to obtain information on the effects of variations in the soil-moisture content above the wilting percentage. In the 4-week and 8-week treatments the fluctuations in soil-moisture content of the principal root zone were all above the wilting range, but in the 8-week plots the fluctuations covered a large part of the range above the wilting percentage. There was not a significant reduction of leaf-growth rate or of yield as a result of these fluctuations. Leaf-growth rate was first affected by water shortage when the moisture content of the

top foot of soil reached the wilting range and when about two-thirds or three-fourths of the readily available moisture had been exhausted from the principal root zone. In the 16-week treatments the reduction of the moisture content of most of the soil of the principal root zone to about the wilting range for several weeks in late summer or fall resulted in moderate reduction in the rate of leaf growth, in rapid drying of ripe fruit and in some delay in the emergence of inflorescences in the spring following the severe drought in the fall of 1954.

Because of high water-holding capacity of the upper 5 or 6 feet of the soil used in this experiment, even the trees in the 16-week treatment were not subjected to severe water shortage except near the end of the summer drying cycles when the fruit was nearly mature. Thus, observations on the effects of severe drought at other stages in the development of the fruit were not possible in this experiment, and it is not unlikely that equally severe water shortage at an early stage, such, for example, as at the fruit-setting period, would have had greater ill effects than in this experiment. It is also probable that in soils, such as coarse sands, in which root concentration is considerably lower than that observed in this experiment, dates would suffer ill effects from water shortages at relatively high levels of soil moisture (9). Under the conditions of this experiment, however, neither the leaf-growth rate nor the yield was significantly affected by water shortage as long as practically all the soil in the root zone was above the wilting percentage.

The long intervals between irrigations were used in this investigation merely to observe the effects of wide variations in the water content of the soil. The long periods required to re-wet the soil interfered with orchard operations and after several days of irrigation the rate of water penetration was slow. Furthermore the problem of salt removal from a root zone 20 feet or more in depth is greatly complicated when the soil is allowed to dry to considerable depths between irrigations. For these reasons the use of long intervals between irrigations in routine practice cannot be recommended even on heavy soils. It is obvious, however, that even on soils that will hold somewhat less water at field capacity than that used in this work, it would not be harmful to withhold water for fairly extended periods during harvest or at other times when it may not be convenient to maintain the usual irrigation schedule.

SUMMARY

In a replicated irrigation experiment with 18-year-old Khadrawy date palms on a stratified alluvial soil, four irrigation treatments, consisting of variations in time interval between applications of water as follows: 2, 4, 8 and 16 weeks, were maintained for 2 years, 1953 and 1954. It was found from sampling roots to a depth of 20 feet that feeder-root concentration was high in the silty soil of the top 5 or 6 feet and, except in silty strata, very low in the sand that extended from a depth of 6 or 7 feet to 20 feet or more. In the 2-, 4- and 8-week treatments the moisture content of the soil in the top 5 or 6 feet, the principal root zone, fluctuated between field capacity and various levels from just below field capacity to just above the wilting percentage. In the 16-week treatment in late summer or early fall the moisture content of most of the soil in the principal root zone was reduced to about the wilting range in both years and in 1954 much of the soil of the principal root zone remained in the wilting range for several weeks. In 1953 the variations in the moisture content of the soil in the 2-, 4- and 8-week treatments did not have a significant effect on leaf-growth rate or on yield. In 1954 the interval between irrigations was lengthened on all treatments during the harvesting period and water shortages were greater than in 1953, but as long as the moisture content of all the soil in the principal root zone remained above the wilting range, neither yield nor leaf-growth rate was significantly reduced by water shortage, though there was a slight (non-significant) progressive decrease in leaf-growth rate from the 2-week to the 8-week treatments. Allowing much of the soil in the principal root zone of the 16-week treatment to remain for several weeks in the wilting range resulted in significant reductions in leaf-growth rate and fresh weight of fruit and caused a delay in emergence of inflorescences in the following spring. Because the fruit was mature or ripening when water shortage occurred, there was no significant reduction in yield. Leaf-growth rate was first affected by water shortage when about two-thirds to three-fourths of the readily available moisture was exhausted from the soil of the principal root zone and at about the time the moisture content of the top foot of soil reached the wilting range.

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COSTS AND METHODS IN REMOVING DATE PALMS

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The subject of removing date palms has been considered previously in meetings of the Date Institute. At the 24th meeting P. W. Van Der Meid reported he had bulldozed out and windrowed 200 palms for a cost of \$2.25 per palm. At the 30th Institute R. S. Dillman reported he had dug out 720 Khadrawys by hand, cutting a notch in the trunk some distance under the soil surface and pulling the trees over with a tractor. He figured the total cost amounted to about \$2.25 per palm. The purpose of this paper is to report on the methods and costs of more recent removals in the Coachella Valley.

The lowest cost job encountered involved the removal of 825 palms early in the winter of 1954. They were bulldozed out and windrowed at a cost of \$2.50 per tree. They were burned in the fall of 1954 and are now in the spring of 1955 being burned again. This owner hired the work done by the hour. He cautions that he did considerable damage to the first row of palms left standing next to the burning palms which were about 200 feet away. Apparently the burning should be kept 300 feet or more away from vegetation which one would not want damaged.

The second case involved the removal of 199 trees in 1955 by a contractor who got the job through a competitive bid. The leaves were removed first by the owner, the contractor then bulldozed and windrowed the palms at a cost of \$4.00 per tree.

At another ranch 91 trees were

bulldozed and windrowed in 1955 for a cost of \$6.00 per tree.

A fourth job completed in 1953 involved a drag of $\frac{1}{4}$ to $\frac{1}{2}$ mile to get the palms to the burning ground. To do this work two bulldozers were hired at a total cost of \$22.00 per hour. The trees were pushed out of the ground and then dragged to the burning grounds. Cost for the whole job amounted to \$6.25 per tree.

Another owner reported he didn't have a suitable place to burn his palms so he rented some ground for one year. The average haul from the garden to the burning ground was one-half mile. Total cost for removal and hauling amounted to \$6.75 per tree.

The highest cost job involved removal of 400 palms which had to be hauled an average of a mile and a half. One operator bulldozed the trees out and filled the holes for \$3.00 per palm. Another with a winch truck and a dolly hauled the trunks over the road to the burning ground at a cost of \$6.50 per tree. The total cost for removal in this case was \$9.50 per palm.

Several growers were interviewed who reported removal of palms by simply digging them out by hand and pulling them over with a small tractor. Palms dug by this method have a good ball of roots and a limited quantity of these are in demand for planting around new homes, golf courses and the like. The palms are usually given away for their removal.

Cost to hand dig a palm is apparently between two and three dollars. One man has removed alternate rows of dates and planted two rows of citrus in the middle. He feels he will get considerable frost protection from the remaining rows of dates. He has removed the palms by cutting them off at ground level with an axe at a cost of about fifty cents apiece. He then drills a hole in the remaining stump large enough to accept dynamite sticks used to split the stump open. With the proper technique and good luck the stump will split deep into the ground. It is then left to dry out for about six months at which time it is doused with oil and burned. When properly dried the stump will burn into the ground far enough to allow for farming right over it.

Because of the relatively few palms being removed at present, efficient methods have not yet been perfected and the job is quite costly. It would seem that in the event a large acreage were to be removed a competent logger might be able to make suggestions to cut the costs. The problem of locating burning areas will become increasingly important as the valley is fully developed.

In summary present per acre costs for removal would seem to be about as follows:

Bulldoze out and windrow	\$240.00
Relevel	20.00
Burn, re-pile and re-burn, rent on idle land	50.00
Total per acre cost	\$300.00

SIZE AND CHECKING OF DEGLET NOOR DATES AS AFFECTED BY FRUIT THINNING AND POLLEN

By Roy W. Nixon

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The size and time of ripening of dates are influenced by fruit thinning (8, 10, 11, 12) and also by the kind of pollen, an effect known as metaxenia (1, 2, 3, 4, 5, 6, 7, 9, 13). When size is increased by fruit thinning there is an increase in susceptibility to checking and blacknose, but evidence has been lacking as to whether or not differences in size produced by different kinds of pollen are also accompanied by differences in susceptibility to checking and blacknose. Furthermore, the extent to which fruit thinning and pollen in combination may affect the fruit has not been shown. Obviously these are important considerations because all bunches are pollinated, and, in commercial practice in the United States, all bunches are thinned. An experiment was planned in 1954 to answer these questions.

EXPERIMENTAL PROCEDURE

The study was conducted at the U. S. Date Garden with 13 Deglet Noor palms 19 years of age and 9 bunches on each palm. Pollens from three different males were compared on every bunch and three different levels of thinning were compared on every palm. The males were chosen because of the effects their pollens had been found to produce in previous experiments: Fard No. 4, small fruit and early ripening; Barhee A-19, fairly large fruit and midseason ripening; Crane, large fruit and late ripening. Each pollen was applied to one-third of the strands on a bunch. This was done by bagging and by using special care to prevent intermixture of pollen.

The number of strands on every bunch was reduced to 39, 13 for each of the three pollens. As there were originally 60 to 110 strands on each bunch, this initial reduction in size of bunch by strand removal varied from about 35 to 65 per cent. Of the 9 bunches on each palm, 3 were given "light thinning" (tips of strands cut back so as to remove about 1/10 of the flowers, leaving 75-90 per strand), 3 were given "moderate thinning" (tips of strands cut back so as to remove about 1/3 of the flowers, leaving 50-60 per strand), and 3 were given "heavy thinning" (tips cut back so as to remove about 2/3 of the flowers, leaving 25-30 per strand). After the differential thinning, the total average bunch reduction in the different treatments was estimated at about 55 per cent for

light thinning, 67 per cent for moderate thinning, and 83 per cent for heavy thinning. At time of ripening the number of dates per strand on bunches having a normal set was about 35 to 50 for light thinning, 20 to 30 for moderate thinning, and 10 to 15 for heavy thinning.

Records were kept of the fruit produced by each pollen in each thinning treatment on each palm. The "yield per bunch" (Table 1), which would have resulted if each pollen had been applied to an entire bunch, was calculated from these records; it repre-

sents the sum of the yields for three replications, each on one-third of a bunch.

From the first picking, a sample of 100 dates was taken from each thinning and pollination treatment — a total of 9 samples from each palm. Before sampling, obvious culls—fruit showing bird pecks, advanced rot, and very pronounced shrivel — were removed; otherwise, approximately the same number of dates was taken from each bunch. The samples were weighed and then graded for amount of checking. After that the dates

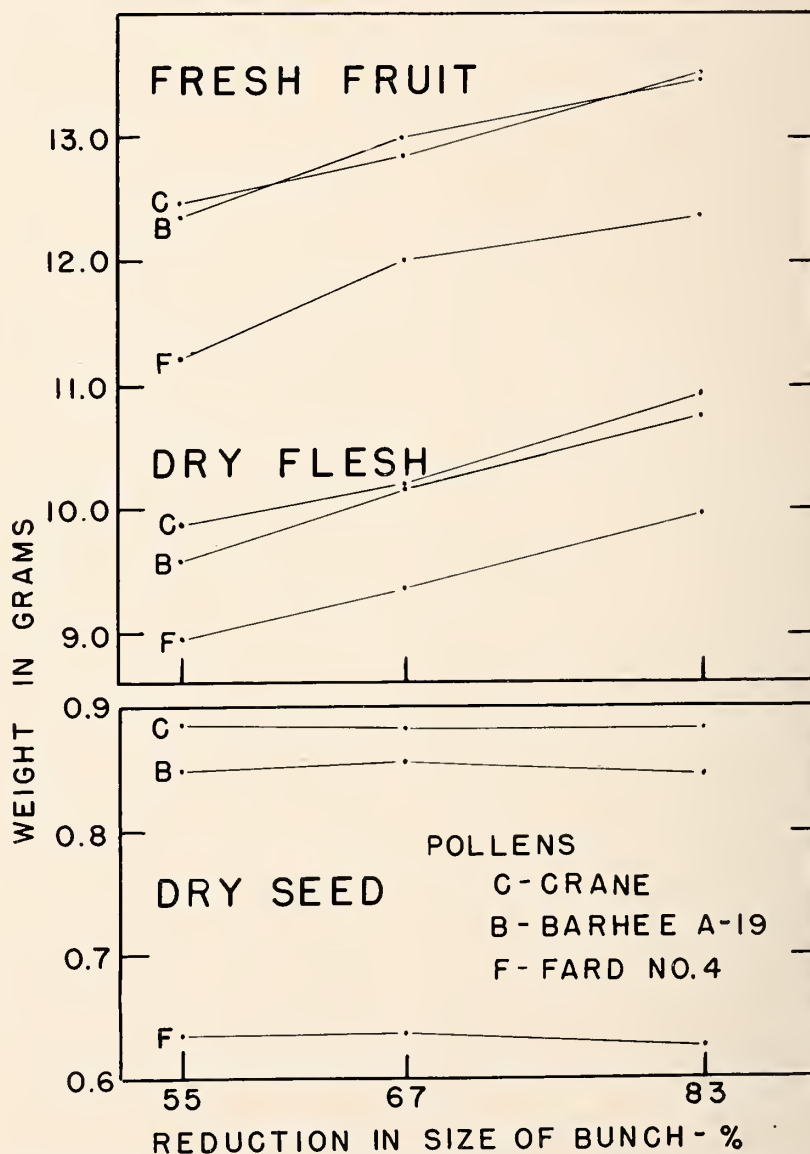


Figure 1—Average fresh weight of fruit and dry weights of flesh and seed of Deglet Noor dates from bunches thinned differently and pollinated with three different pollens on different strands.

were cut, the seeds were removed and both flesh and seeds were spread out on shallow wire-bottom trays and dried until they were air-dry, as indicated by very slight further weight loss.

RESULTS AND DISCUSSION

Differences in ripening began to show up at the time the fruit began to change color from green to the light red characteristic of the khalal, or preripe, stage of the Deglet Noor variety. Fruit from Fard No. 4 pollen colored and ripened at least a week in advance of that from Barhee A-19 pollen and the latter was about 8 or 10 days ahead of fruit from Crane pollen. These differences appeared in the picking record. Fruit from the different pollinations was picked at different times so that all lots would be harvested at about the same stage of maturity. About three-fourths of the total crop from Fard No. 4 pollen was harvested in the first picking on September 13, and about the same proportion of that from Barhee A-19 was harvested on Sept. 20, but the proportion from Crane was slightly less on September 27.

The large proportion of the crop harvested in the first picking was a result of an unusually early season. Except for a small clean-up picking of a few late bunches on November 22, the harvest was completed by a second picking of fruit from the pollinations in the same sequence on October 6, 15, and 25.

Table 1. — Average yield in pounds per bunch of Deglet Noor dates from bunches pollinated with different pollens and thinned differently.

Pollen	Thinning Treatment		
	Light	Moderate	Heavy
Fard No. 4	15.90	14.08	9.00
Barhee A-19	22.81	19.59	12.48
Crane	22.58	17.54	11.75

The average yield per bunch (Table 1) was reduced somewhat in proportion to the amount of thinning, as was to be expected. There were differences in yield per bunch from the different pollens, but most of the low yield per bunch from Fard No. 4 pollen can be explained by the poor sets resulting from this pollen as com-

pared to the other two. Also the set of fruit from Barhee A-19 was enough better than that from Crane to account for the slight differences in yield per bunch resulting from these two pollens.

The small fresh weight per fruit (Fig 1) resulting from Fard No. 4 pollen would account for at least a small part of the much reduced yields per bunch when this pollen was used. Fresh weight per fruit from Barhee A-19 pollinations was about the same as that from Crane pollinations, although, as mentioned previously, the latter was definitely later than the former in time of ripening. This difference in time of ripening was greater than might have been expected because in previous experiments large size of fruit produced by pollens from *Phoenix dactylifera* males has been associated more or less with late ripening. The data suggest that the correlation between size of fruit and time of ripening is not as close as was previously thought. This is important because late ripening is not desirable in some localities with some varieties, but it is always desirable to obtain the maximum size possible with pollen.

Fruit thinning increased the fresh weight of the fruit and the dry weight of the flesh, but it had no appreciable effect on the dry weight of the seed (Figure 1). Regardless of the pollen represented, the average weight of both fresh fruit and dry flesh was slightly more than 1 gram more on heavily thinned bunches than on lightly thinned ones. The differences represent average increases of about 10 per cent in weight per fruit. The differences in size of fruit produced by Fard No. 4 pollen on the one hand and by Barhee A-19 and Crane pollens on the other were of about the same magnitude as those produced by fruit thinning and were about the same at the different levels of fruit thinning. Large differences in size of seeds were produced by the pollen: the dry weight per seed from Barhee A-19 pollen was about 34 per cent greater than that from Fard No. 4 pollen and about 40 per cent greater from Crane pollen than from Fard No. 4.

Accompanying the increase in size of fruit produced by thinning, there was an increase in amount and severity of checking and blacknose similar to that in previous experiments (Figure 2). On the other hand, the increase in size of fruit due to pollen was not accompanied by an increase in checking. Instead, less checking occurred on the large dates than on the small ones. Because of the later ripening of the large fruit and because more checking occurred on the early ripening of the large fruit and because more checking occurred on the large dates than on the small ones, the results cannot be taken as con-

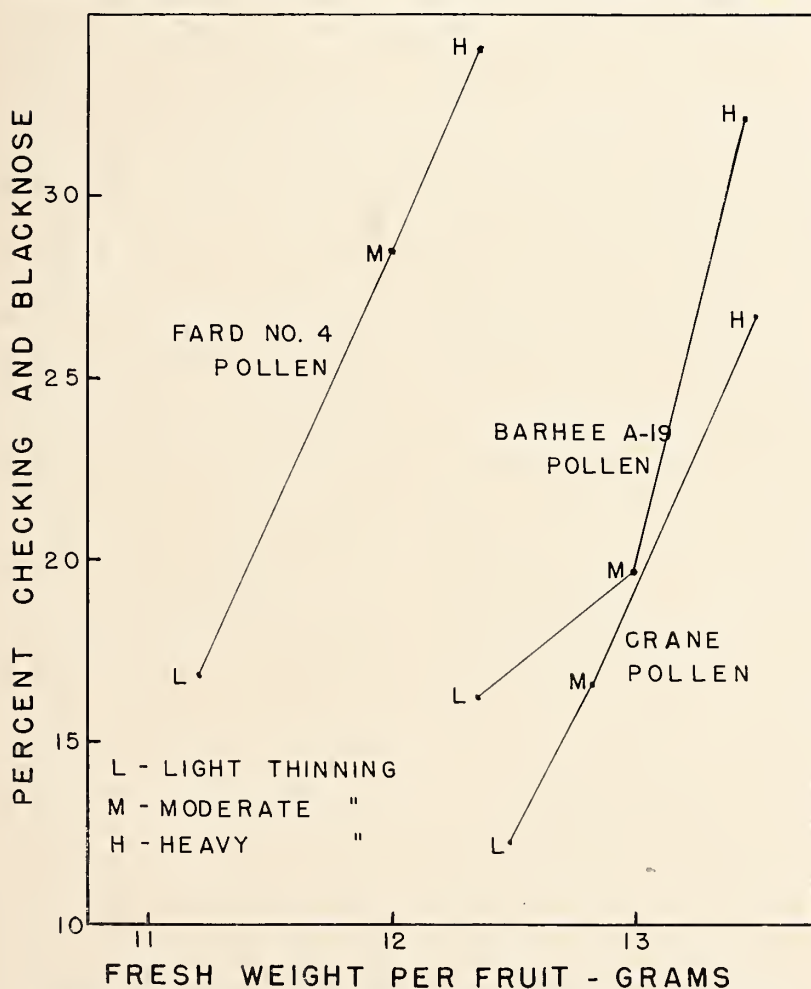


Figure 2.—Percentage of Deglet Noor dates with severe checking and blacknose in relation to size of fruit as affected by amount of thinning and by kind of pollen.

clusive; but the data strongly suggest that at least no increase in susceptibility to checking accompanies an increase in size of fruit resulting from a different pollen.

From numerous earlier tests, it appeared that there are few date pollens which produce as small fruit as Fard No. 4. However, there are undoubtedly many pollens which have an effect on size of fruit and time of ripening intermediate between Fard No. 4 on the one hand and Barhee A-19 and Crane on the other. It is not unwarranted to expect, therefore, that in some instances the grower might be able to obtain an increase in size of fruit of as much as 5 per cent merely by using a different pollen variety that produces large size fruit. This is only about half the difference in size of fruit obtained by using Barhee A-19 and Crane pollens as compared to Fard No. 4. An increase in size of fruit caused by pollen might result in a corresponding increase in yield, instead of the decrease in production which results when size is increased by fruit thinning. Even more important than a slight increase in yield is the possibility of an increase in the percentage of upper grade fruit because of the importance of size in grade.

SUMMARY

In an experiment in which different degrees of thinning and different kinds of pollen were used in combination, each factor affected the size of fruit more or less independently of the other. Large fruit resulting from certain pollen was not accompanied by an increase in amount of checking. Because differences in time of ripening of the fruit from the different pollens may have caused the fruit to be in a stage less susceptible to checking when environmental factors were most conducive to it, this result cannot be taken as final evidence that large fruit produced by pollen is less susceptible to checking than that produced by fruit thinning, but it is strongly suggestive that such is the case.

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DATES IN SOMALILAND AND LIBYA

By V. H. W. Dowson

Food and Agricultural Organization of the United Nations, Libya

INTRODUCTION

Mr. Chairman, Ladies and Gentlemen, it is my privilege today to address the Date Institute, but, whereas on the previous occasions I have talked mostly about dates in Iraq, this afternoon my subject is dates in two countries less well-known in America, namely, Somaliland and Libya, both of which are in Africa, a continent, I may mention in passing, which is four times as big as the United States.

SITUATION OF LIBYA

First, let me show you by means of this map where these countries are. Here is Libya, as big as Washington, Oregon, California, and Arizona put together, in the same latitude as Mexico, its northern boundary the Mediterranean Sea, but stretching southwards across a burning desert, where there are no air-conditioned motels, to the desolate Tibesti Mountains, the home of the almost-unknown Tibu tribes.

SITUATION OF SOMALILAND

Three thousands miles away to the southeast of Libya the Horn of Africa juts out into the Indian Ocean,

dividing it from the Gulf of Aden. Here lives a proud, brave, handsome race of nomads, the Somali, independent in character but without political independence, for some of their country forms a part of the Kingdom of Ethiopia, some is French colonial territory, some is a British protectorate, a part is trust territory of the United Nations administered by Italy, and the remainder lies in the British colony of Kenya. The part about which I shall speak is the Protectorate, across the gulf, directly south of Aden, a country of the same size as the state of Washington, but with only a quarter of its population, and lying in the same latitude as Costa Rica.

DESCRIPTION OF THE SOMALILAND PROTECTORATE

This country consists of a narrow, coastal strip on the north, nowhere more than fifty miles wide and for the most part much less than that, then foothills, then a high escarpment running E. and W., rising in some places to 7,000 feet, and sloping gradually away southwards. Somaliland is the country of the acacia; and of

the genus sixty-eight species have been recorded there. The camels, the white, black-headed sheep, and the goats graze on and around these trees. Indeed, as Mr. Lawrie has shown in a recent paper, the acacia is to the Somali what the date is to the Arab or the coconut to the South-Seas islander. The climate in the high places is pleasant enough, but that of the coast is only fit for dates.

BEGINNINGS OF THE DATE SCHEME

Recently the Government has been perturbed by the overgrazing and the soil erosion in the protectorate and the consequent distress among the people, and have been seeking to provide for them other ways of making a living than herding stock. In 1944 it was suggested that date cultivation might succeed, and a few hundred shoots were obtained from the Hadhramaut coast and planted out in Somaliland. Of this planting some eighty palms now survive in the experimental garden of Takhushi, near the French frontier. The following year, 1945, I was asked to visit the country and to report on the prospects of date cultivation there. I was not

able, however, to accept the invitation till 1947, when I reported that parts of the coast and of the foothills appeared favorable.

REASONS FOR FAVORABLE REPORT

My conclusion was based on the following considerations. Climatic records, as far as they went, showed the winter as not too cold for dates and the summer as probably hot enough. It appeared likely that the rainy seasons would miss flowering and harvest. In several places there was sweet water and in many others there was water probably not too brackish for dates; but what appeared even better reasons for believing this crop could be grown were that in the protectorate palms were already growing, not only at Takhushi, but also in three small groves, that, in other places, an occasional seedling palm could be found to have established itself near a well, and that dates were being grown commercially in a small way to the westward in one oasis in French territory.

THE THREE GROVES

The three small groves were of particular interest. Two were of seedling palms, the third mostly of established varieties. My visit was made in the fall after harvest, so that I could see none of the dates that had been produced in the third grove, for they had all been sold and eaten fresh, that is to say as *rutab*; but, instead of the wide variations in foliage that are found in seedling plantations, the palms in this grove, at a place called Dubaar, seemed to fall mostly into four or five groups. Furthermore, the contractor who picked and sold the fruit stated that it was all of good quality, not inferior to the dates imported from Basra. Moreover, the palms in this grove, which sheltered springs supplying fresh water to Berbera on the coast seven miles away to the north, were said to have been planted by the Egyptians, who occupied the coast till 1884. It was reasonable to suppose that these people, coming from a date-growing country and being, therefore, familiar with date cultivation, would have made a plantation of varietal shoots rather than of seedlings.

The two other groves were clearly of seedlings, because the foliage of the palms was widely diverse and some of it of types not seen in varieties; but I was puzzled by all the palms being dwarf. There were great thickets of concentric circles of children, grandchildren, and great-grandchildren, but where were the original parents? Why did no dark trunks rise up amongst all the greenery? Were the palms not *ductylifera* at all? They were certainly not *reclinata*, the only dwarf *Phoenix* with which I

was acquainted. Was this a new species? The question was answered as I wandered through the grove near Berbera early one morning, when I found the Somali women pulling cut the heart fronds for weaving into mats. As soon as a palm tried to grow upwards, the women pulled its head off, so that the poor thing could only grow sideways.

This grove, and the third one, on the coast, fifty miles to the west, arose on the site of relief camps maintained by Government in famine years during the early thirties. A part of the ration was dates; and it would seem that the pits were never disposed of in a sanitary manner in an incinerator, but fell to the ground, where some of them must have germinated.

The Berbera grove (Baarakallah) was the name of the place where it lay (was close to the sea; and the sub-soil water, which was two or three feet below the surface, was undrinkable and contained half as much common salt as sea water. Said I to myself, "No palm can grow in this water;" but then I looked around and there were palms actually growing. I preferred to accept the evidence of my own eyes to being guided by what the professors write in the botany books; but, as is so often the case, the professors were right; and when, later, I planted out shoots at Baarakallah, not more than one or two in a thousand survived. About the only thing one can cultivate successfully in water containing more than 1,000 parts of salt in a 100,000 is the mangrove. It was only then that it occurred to me to calculate from the weight of dates probably issued to the refugees how many pits it had taken to produce the few hundred palms then growing. The number of the pits might have been 100,000,000, and the successful few had probably got a start during a year of flood. Even so, it appeared that only about one in 300,000 had managed to take root and survive.

It may be mentioned here that, when this grove was protected from the mat makers, the palms shot upwards, some making perhaps eight feet of growth in four years. I should add that only 200 imported shoots were planted at Baarakallah: the rest were male shoots from Baarakallah males for a hedge.

HUMIDITY

From inquiries made in 1947 it appeared that the dates from the few hundred palms at Dubaar, the only ones then bearing in the protectorate, were all consumed as *rutab*, as I have already mentioned; and I found that those grown in the little oasis of Ambari in French territory were also all eaten fresh. Such climatic records

as were available showed on the whole a high humidity in Berbera with a sharp rise in the fall. The records for Djibouti in French territory were fuller than those in the protectorate, and showed a high humidity all the year round. I was, therefore, uncertain whether dates grown on the coast, if left on the palm and not cut off as *rutab*, would ripen properly into *tamr* or not. I inclined to the belief that they would do so, but I could not be sure. However, the matter was settled in 1950, when the fresh dates were not sold to a contractor but were left on the palm and protected from the baboons, porcupines, jackals, flying beetles, crows, and hungry wayfarers. In their season they ripened into excellent *tamr*. What I had not realized fully in 1947 was that the scorching southwesterly monsoon, which blows over the coast of Somaliland from mid-May to mid-September, coming from over Africa, makes the air hot and dry right up to the edge of the sea, so that, although in Berbera and Djibouti towns, both half surrounded by water, where the recording instruments were, the air might be almost saturated, yet, a short distance inland the air would feel as dry and hot as the blast from a furnace.

COLONIAL DEVELOPMENT AND WELFARE

The Government of the Somaliland Protectorate and the Colonial Office agreed with my opinion that the Somaliland coast appeared suitable for date growing and with my suggestion that experimental plantings should be made with imported shoots; and the Colonial Office voted out of the Colonial Development and Welfare Fund the equivalent of \$126,000 for the conduct of an experiment to extend over six years.

THE DATE SCHEME

Although it was in 1947 that I was offered the job of running the Date Scheme, as the experiment was called, I did not arrive in Somaliland to begin work till January 1950. There was much to be done. Sites had to be selected for the experimental, date-introduction stations in a country where roads were few and bad, maps inaccurate, where electricity and water supplies were to be found only in a few small towns, and where the knowledge of any form of agriculture was restricted to a very small part of the population. No camel had been trained to draw water from a well, and irrigation machinery was confined to the bucket. What cultivation there was was mostly of sorghum on the high land near Ethiopia, but it probably did not cover more than a few thousand acres. On the coast, where the date palm might be expected to grow, there was virtually no cultiva-

tion. There was, therefore, no agricultural tradition, and the laborers had to be taught their work from the beginning. The Somalis, however, are an intelligent people, learning quickly, and working well. I was fortunate, also in being given an indefatigable clerk, Mr. Machaiah from Malabar, and a zealous assistant, Mr. Aden Hajji Ahmed en-Naaliya, who, though not knowing anything of date cultivation to begin with, profited by his trips with me buying shoots in the Arab lands to learn a great deal.

IMPORTATION OF SHOOTS

Over 4,000 shoots were imported from seven different date-growing districts, Bahrein, Hasa, Masquat, Hadhramaut Coast, Hadhramaut Valley, the Sudan, and Tunisia, chiefly of the four or five commonest varieties in each place.

MORTALITY

Unfortunately, more than three-quarters of the shoots have died. Why I do not know. It may be because we did not irrigate enough; and I hope an irrigation experiment started last year at Batalaala near Berbera will tell us how much water is required. It is curious, however, that the palms that did strike made rapid growth. Some produced appreciable quantities of dates only three years after planting. The Tunisians did by far the best. They were the last to be imported, and had been selected and removed from their parents with more than ordinary care. They were the only ones to have been planted out in a nursery in the cooler highlands before being planted out in their permanent positions on the coast. In the four months during which they were in the nursery only nine out of the 700 odd died. All the rest made much root growth, one of them even producing a root a yard long. I hear, however, that there have been many deaths since they were planted out on the coast. It should be mentioned that mortality is by no means uniform in the different plantings. An example of a good result is that of Dubaar, where of 148 Dubaar shoots planted 147 survived and grew rapidly, several flowering three years after planting, although all were small shoots when planted.

TRANSFER TO LIBYA

I should have liked to have accepted Government's invitation to remain in Somaliland after the end of my contract, amongst a people I had grown to respect and like, and to have tried to find out what it was that was causing so much mortality and to have tried to establish the date industry firmly, but my wife wanted to live somewhere where there

was a school. I therefore went to Libya, handing over the Date Scheme to Mr. R. McIvor.

PROGRAM OF DATE WORK IN LIBYA

The work awaiting me in Libya was different from that which I had left behind. In Somaliland the job was to make palms grow in a place having a climate which, once the palms did grow, permitted the production of first quality dates. In Libya, where, on the coast, there were plenty of date palms growing, the quality of the fruit was poor; and, for this reason, Government asked the Food and Agriculture Organization, one of the specialized agencies of the United Nations Organization, to send someone to investigate the possibility of improving it. The F. and A. Organization, therefore, in the same way that they had already sent Mr. Winter to Iraq and Mr. Carlson to Arabia, sent me to Libya.

THE COASTAL DATES

The United Kingdom of Libya is divided into three provinces, Cyrenaica in the east, Tripolitania in the north-west, and the Fezzan in the south-west. Where most of the dates are grown, ignoring for the moment the oases in the far south, is on the coast of Tripolitania, where, scattered along a strip ten miles wide and 250 miles long, grow two million palms, producing perhaps 40,000 tons of dates.

CLIMATE

The climate of the coast is of the Mediterranean type, with winter rain and dry summers. The temperature is seldom high, and the air is generally humid, as may be seen from the figures on the board. An average maximum temperature for September of 87 degrees and a 66% humidity at eight o'clock in the morning are clearly not conditions for the production of good keeping dates; and, in fact, no proper *tamr* are produced on the coast. Perhaps because of the humidity much of the plantings, as in lower Egypt, are in widely separated rows, allowing room for considerable intercultivation.

VARIETIES

Good, but not excellent, *rutab* are produced by the Beiyudhi and Tabuuni palms. Less good *rutab*, less good because more flavorless and less sugary, are those of the Burunsi and Hamraawi. Lemsí, whose original home was the island of Djerba in Tunisia, and Hallaawi are early, and are eaten in the *khalaal* stage, because they are less astringent than the other varieties.

BIKRAARI

The varieties already mentioned form only a small part of the coastal palms: by far the greater number

belong to the Bikraari variety. Some of its dates, if left on the bunch long enough, and if the weather remains sunny and dry, will go straight to a somewhat tough and leathery *tamr*, without passing through a *rutab* stage. Some of the Bikraari crop is eaten as *khalaal* by the poorer people, for, being less sweet than the others mentioned, it is sold more cheaply. The greater part of the Bikraari crop, however, and, therefore, all of the coastal dates, is stamped into baskets after sun drying.

PITTING, DRYING, AND PACKING

The Libyan cultivator uses one of the most efficient, and certainly the cheapest, of pitting machines — his family. The dates of each day's picking are split into two, deprived of their pits, and spread on mats. At night and during showers, the dates are collected into heaps and covered over or brought into the house or tent, much, as Mr. Nixon has recounted, as is done in Baja California. After about a week's drying, the dates are pressed by foot tightly into palm-leaf or esparto-grass baskets, weighing, when full from forty to two hundred and forty pounds. If there has not been too much rain during harvest, if only the sound and more mature dates have been selected, if they have been sundried thoroughly, if pressing to exclude the air has been heavy, and if the store-room has been kept dry, the Bikraari date will keep in baskets for a year; but, in practice, most of the crop lasts in good condition, good condition for Bikraari that is, only until the spring. Fermentation frequently sets in; but a more serious trouble, more serious because more difficult to prevent, is a decomposition accompanied by a darkening in color and a change in texture of the flesh from firm to crumbly, which is probably due to enzyme action. Our experiments have shown that proper, artificial dehydration prevents both kinds of decay.

KHADHRAI

There is an export to Tripoli of good quality dates grown in a group of oases called Jufra, lying 250 miles inland; but the total quantity is only a few hundred tons. The most important of the export varieties is called Khadhrai, whose date resembles the Khadraawi of southern Iraq, and which has greenish *rutab*. Most of these are shipped without treatment loose in tea chests and still attached to the stalklets through Tripoli for repacking in Italy. The cost of these dates, however, is high, 7c a lb. on wharf Tripoli; and they can compete with the Deglet Nuur imported from French North Africa only because Italy waives the duty on Libyan

produce but not on dates from elsewhere.

With equipment provided by FAO and by the Libyan Public Development and Stabilization Agency, whose funds came mostly from the British Government, we made up in 1953 various small packs of Khadhrai after grading, cleaning, and pasteurizing, and tried them on various European markets; but they could not compete with the pitted, half-pound blocks of equally good Iraqi dates, which were being sold wholesale, duty paid, landed London, at 4¼ c a lb.

FEZZAN AND CYRENAICA

Across the desert, 600 miles south of Tripoli, are the numerous, scattered oases of the Fezzan. M. Pereau-Leroy, a French date expert from Morocco, who has twice visited the region, says that there are ten million date palms there, and that only one million of them are pollinated. Late in the fall a few trucks make their painful way up to Tripoli across the sand and the mountains, but the dates they carry are as hard as stones, and for the most part find a sale only amongst the nomads.

Good dates are said to be grown in the oases of Cyrenaica, but these are even more inaccessible than those of the Fezzan; and Rholf's description of the dates of Kufra, written in 1887, is still the fullest we have.

FUTURE PROGRAM

From the results of our trials in 1953, it appeared that future, date, packing-house work would have to be directed to improving the Khadhrai bulk export to Italy, cheapening the Khadhrai small pack for the local, town market, and to devising methods for making available the advantages of dehydration and fumigation to the growers and merchants of Bikraari along the coast.

SCHOOL-FEEDING PROGRAM

These activities, however, have recently had to give place to something else, for the Government has agreed to cooperate with UNICEF, another of the UNO specialized agencies, in the provision of free lunches to the children in Libyan state schools. UNICEF will provide milk and other things while Government will provide dates,

three and a half ounces a child a day; and it is due to this agreement that I now find myself in the happy position of being able again to meet my old friends in Indio, for, since the Government has decided to use the Bikraari date for the program, to make it fit for the job we must have cleaning, washing, drying, grading, dehydrating, and pressing machinery; and I have been sent here to obtain it.

CONCLUSION

In conclusion, I am sure my Libyan friends would wish me to say that they are conscious that they are doubly in America's debt, for not only is this country providing milk for the children at a specially low price, but right here in California she is building the equipment which will make possible the fulfillment of the humanitarian project sponsored by FAO and UNICEF.

APPENDIX METEOROLOGICAL DATA FOR TRIPOLI, LIBYA, 1954

Month	Temperature Max.	Degrees F. Min.	Monthly Averages Humidity %		Rain Inches
			08.00 hrs.	14.00 hrs.	
June	91	68	59	42	1/5
July	86	68	69	53	
Aug.	87	68	67	47	
Sept.	87	68	66	46	
Oct.	79	60	66	50	1-1/3
Nov.	73	54	60	51	2

NEW DEVELOPMENTS IN PAPER BAGS

By T. R. Brown, Grower

Returns from dates for the last few years have encouraged growers to economize in all phases of growing and packing operations. I have been asked to report on changes in covering date bunches with paper bags. Annual increase in the price of creped paper cylinders commonly used brought the prices to \$174.95 in 1954, and the next year's price will be no lower. While these bags are often used two or three years, the labor cost of removing and the problem of storage keep the annual cost high.

Mr. Leonhardt Swingle encouraged one of the paper companies to try out a flat waxed sheet in 1953 and many of us used them. They cost about 3½c and were fairly successful, but often became torn by wind or came unwrapped from the bunch. They were discarded with the fruit stem.

A creped flat sheet was made available in 1954, and offered in two sizes, 40" by 40" and 40" by 48". The former cost \$32.56 per M, and the latter \$40.70. The creped paper proved much stronger than the flat and was successful. No attempt was made to save the bags after harvest. A size

48" by 48" would, in my opinion, give better protection.

Mr. Swingle changed from the traditional method of tying the bag to the fruit stem with soft string. He used a paper-covered wire. A rolling hitch with a twist to prevent slipping, was used. He found the wire quite successful, and quickly tied. I also have tried the wire, and found it satisfactory. A twenty inch length is adequate.

We used the paper cylinders on nine acres of twenty-two year old palms, and wrap-around sheets on fourteen acres of trees ranging from eight to twelve years. Grade reports on the older palms revealed 6.5% substandard and culls, and on the younger trees 7.9%. The 1.4% increase in the poor fruit of younger palms could have been due to other causes than the paper bags.

A severe wind and rain storm on the night of August 31, 1955, put all bags to a severe test. We replaced a few of each kind, but far fewer than we expected.

To find if it had paid to bag at all I checked with a neighbor who did not bag an eight or nine year old

Deglet Noor block. Since we had both dusted with Malathion, and used other similar practices except bagging, I thought the comparison fair. His substandard and cull fruit from this block amounted to 19.5%. Our production on the younger trees of comparable age, was 7,105 pounds per acre, with culls and substandard of 7.9%. By assuming that we would have a similar grade out with unbagged fruit, we saved 11.6% of the crop, or 824 pounds. This, at 7c per pound equals a saving of \$57.68 per acre, less the cost of bagging (\$40.56 labor and bag), plus extra cost to the neighbor of picking and hauling the substandard and culls, for which he got no returns, amounting to \$11.75. This equalled a saving to us of \$28.87 per acre, due to bagging.

Bird damage is so severe in our locality that we will continue using the long paper cylinders on soft fruit. While the largest grower of soft dates in the valley does not bag, we do not believe we could afford to grow unprotected fruit in our location. Some growers are willing to gamble on the weather, but I regard bagging expense as one of the essentials of date growing. I can remember few years without a rain during the critical ripening period. I believe too, that we should be alert to opportunities to keep growing costs at a minimum.

RESULTS OF EXPERIMENTS ON CONTROL OF FRUIT SPOILAGE OF DEGLET NOOR AND SAIDY DATES IN CALIFORNIA, 1935-1954¹

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Department of Plant Pathology, University of California Citrus Experiment Station

1. Paper No. 859, University of California Citrus Experiment Station, Riverside, California.

Investigations on the control of date fruit spoilage have been conducted by the University of California Citrus Experiment Station since 1935. Spoilage has been recognized as a complex involving water injury, checking and blacknose, injury by insects, fungi, and birds, and mechanical injury. In the Department of Plant Pathology special emphasis has been placed on the control of fungus spoilage, especially since the use of fungicides was introduced, about 1943.

It is the purpose of this paper to review and summarize (a) the extent of fungus spoilage encountered in these studies, particularly in regard to the Deglet Noor and Saidy varieties, (b) the effects of various treatments to control spoilage, and (c) the benefits achieved through such control.

Figure 1 presents a summary of fungus spoilage in the Coachella Valley on Deglet Noors given various treatments from 1935 to 1954, excluding the years 1942 and 1952. The basic treatment selected for comparison with other treatments was that using the paper-bag date-bunch cover alone. This was considered the minimum treatment common to the greatest number of growers. The treatments considered for this review have been (a) the insertion of the wire ring in the center of fruit bunches for better aeration (1, 2, 4) and (b) the application of a fungicide for the control of fungi. Insofar as possible we have selected uniform locations so as to give a relevant comparison from year to year. Thus results are presented for 10 years from the U. S. Date Garden, Indio, for 7 years from the Mitchell ranch, Indio, and for 1 year each from a ranch near Oasis and from the Odium ranch also near Indio. As will be noted later, this does not give the true picture of spoilage for a given year, because spoilage may range from 5 per cent in one location to 75 per cent in another.

From figure 1 it may be seen that fungus spoilage of more than 25 per cent has occurred only three times since 1935, and that spoilage of more than 50 per cent has occurred only once in the same interval. The statement has been made (3) that serious spoilage occurs about once in 5 years. This is a fair average, for we see that substantial losses were encountered in

1935, 1939, and 1945. With the exception of severe local losses in 1946 and 1947, to be noted later, no spectacular losses from fungus spoilage have occurred since 1945. The weighted mean loss since 1935, on fruit covered with the paper bag only, was 8 per cent. Spoilage above this value occurred in 8 years and below it in 10 years.

The use of wire rings in date bunches was first suggested by Swingle in 1931 (4). Subsequent tests made by Bliss from 1936 to 1939 (figure 1) showed that rings reduced spoilage in 3 of the 5 years. Bliss (3) thought that the rings' greatest value was in promoting aeration, thus reducing losses from water injury. Such aeration was also beneficial from the standpoint of fungus spoilage, in that moisture required for spore germination was reduced.

Experiments using fungicides were started in 1943. After trying several materials in 1943, 1944, and 1945, Thiomate "19," a 5 per cent mixture of ferbam (formerly "fermate") in sulfur, was selected for more extensive trials. Spoilage was severe in 1945, and reduction with Thiomate was significant at the 1 per cent level.

Severe losses in 1946 and 1947 on Deglet Noor and Saidy dates at various locations in the Coachella Valley, and on Saidy dates at Bard, California, in the Yuma Valley, again demonstrated the value of the fungicide (figure 2). Statistical analyses showed that reduction in fungus spoilage was significant at the 5 per cent level in two experiments and at the 1 per cent level in four experiments. Figure 2 also illustrates the wide variation in amounts of spoilage from one location to another, reflecting the variation in atmospheric conditions promoting spoilage.

Since the thorough tests given Thiomate in 1945, 1946, and 1947, spoilage has been rather light, and a significant reduction (5 per cent level) with Thiomate was obtained only in 1949. Conditions the past 5 years have been such that spoilage has not been great enough in fruit bunches given the standard treatment (bag only) to demonstrate differences in other treatments. It should be pointed out that experiments since 1948 are not strictly comparable to previous ones, however, because wire rings were inserted in bunches receiving Thiomate after that date.

FUNGUS SPOILAGE SUMMARY DEGLET NOOR VARIETY

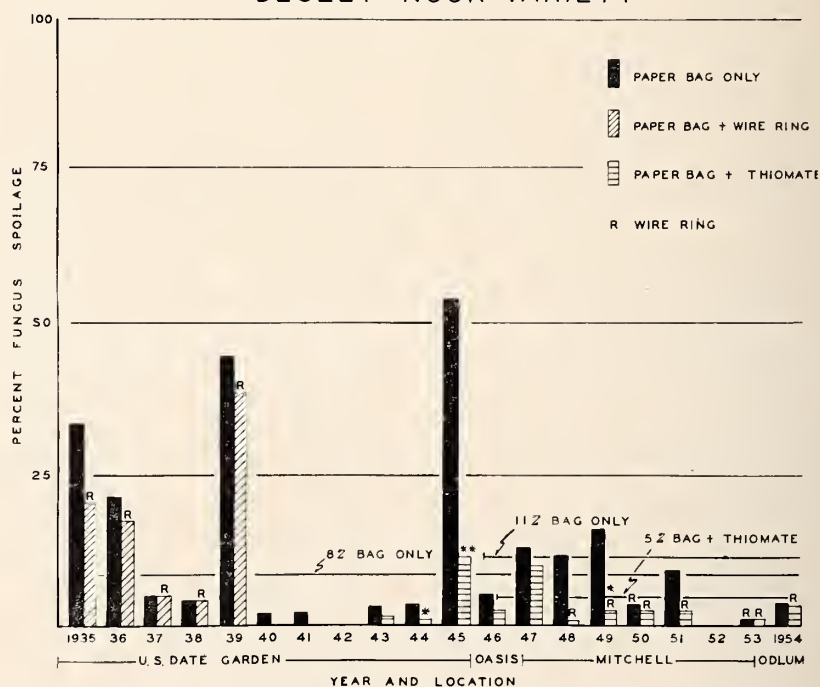


Figure 1.

REDUCTION OF FUNGUS SPOILAGE WITH THIOMATE

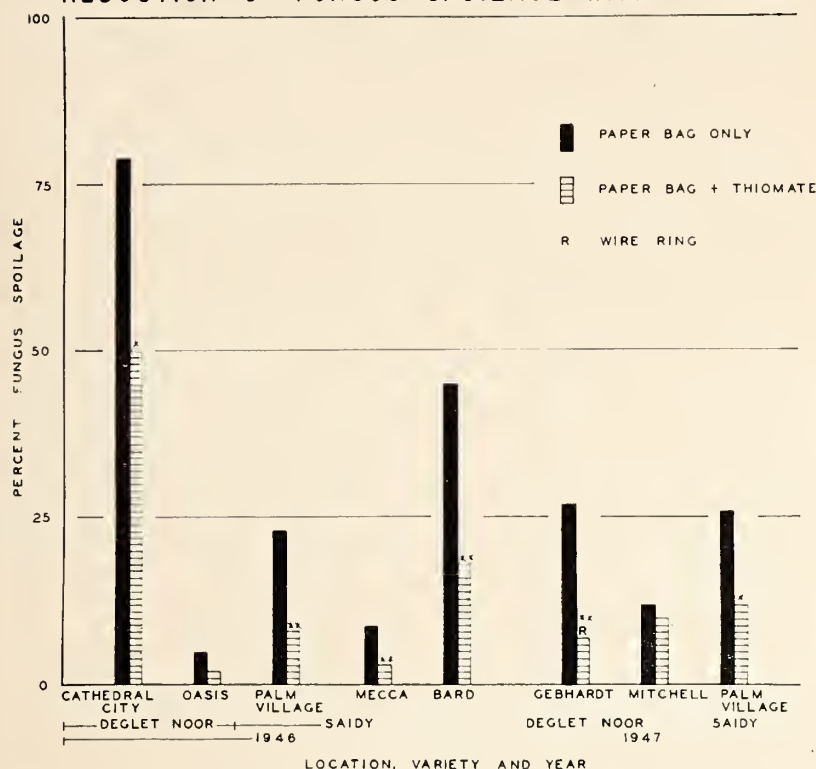


Figure 2.

While Thiomate may not be the best material for use, particularly from the standpoint of ease of application and subsequent cleaning of the fruit for market, it is the only one recommended at present. There is objection to the discomfort in handling sulfur-containing materials during the extreme heat of August, when such treatments are usually applied. Since it is indicated that ferbam is the effective agent in Thiomate, it is possible that satisfactory results may be obtained by substituting an inert dust, such as talc, for the sulfur.

No one should argue concerning the practicability of treating fruit with a proved material in years of severe spoilage. But we are often asked: Does it pay to treat every

year, even in years which may prove to be relatively dry, in order to protect fruit during the occasional wet year? In other words, has it paid to treat during the relatively dry years since 1945?

In figure 1 we see that treatment has reduced date spoilage every year but one since 1945, and that the reduction was significant in 1949. In no case did fruit loss in treated bunches exceed that in nontreated bunches. In general terms, the average fruit spoilage in nontreated bunches was 11 per cent, while that in treated bunches was 5 per cent. Thus, there was a saving of 6 per cent of the fruit as a result of treatment.

The estimated average fruit yield,

cost of treatment for fungus spoilage, and return per acre, 1946-1954, are shown below.

Fruit yield	12,000 lbs.
Crop saved by treatment,	
6 per cent	720 lbs.
Value at 5 cents per pound.....	\$36.00
Cost of treatment	\$ 7.00
Net return	\$29.00
Crop increase required to	
cover cost of treatment,	
1.1 per cent	140 lbs.

Even at a relatively low price for fruit there was a net return of approximately four times the cost of treatment. At the same price level the treatment would have to increase yield only by a little more than 1 per cent to pay for itself. In 1953, fruit quality was the best in the writers' experience, and spoilage was only 1 per cent, the lowest on record. There was no evidence that treatment was of any value; nevertheless, the cost of treatment seemed to be rather inexpensive insurance against what could have been a severe spoilage year.

In our opinion the minimum treatment should be to cover the fruit with bags and to dust with Thiomate. The addition of rings is desirable. Thiomate has reduced spoilage very significantly in years of severe spoilage. The figures presented indicate that even in so-called nonspoilage years, it has paid to treat the fruit.

LITERATURE CITED

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2. Bliss, Donald E. 1940. *Aeration as a factor in reducing fruit spoilage in dates.* *Date Growers' Inst. Ann. Rept.* 17:11-15.
3. Bliss, Donald E. 1946. *The use of fungicides against spoilage in dates.* *Date Growers' Inst. Ann. Rept.* 23:13-17.
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INFESTATION FROM VARIOUS GROWING AREAS IN THE COACHELLA VALLEY

By Robert E. Cook and Hillman Yowell

On August 31, 1954, we had a Valley-wide rainstorm. Because of the stage of maturity of the fruit there was more serious damage in the Oasis district than in any other district in the Valley.

We became interested in the degree of infestation in the various growing areas in the Valley, so we divided the Valley into five production areas: (1) Oasis area, (2) Indio area, (3) Indian Wells area, (4) Palm Desert area and (5) Rancho Mirage area. These were all taken from untreated gardens where no insecticide was used and that delivered fruit every week. They were all gardens with an average level of garden cleanliness. Percentages of hidden infestation for each area was averaged for each week's deliveries. Lots of fruit showing above 4% hidden infestation were set aside and given special handling to bring the percentage within food and drug tolerances.

The months of September, October and November were used because they are the months that temperatures are more favorable for the rapid development of the insects. The months of December, January and February show some infestation but less than 1/2 of 1%. The average temperature for the last week in September was 84.9° and the last week in September was 82°. The average temperature for October was above the 50 year monthly average of 74.2°, being 76.4°.

The chart shows the weekly average percentage of hidden infestation of each garden.

(1) OASIS AREA—The garden in the Oasis area made its first deliveries

the last week in September with an average of 7% hidden infestation. The following five weeks' deliveries were above 4%. The final delivery, November 15, was the only delivery made that was below 4% hidden infestation. Further study revealed that in this garden the bunches were not covered at the time of the rain.

(2) INDIO AREA—The garden in the Indio area made its first delivery the last week in September with an average hidden infestation of 2%. The following two weeks were above 4%. The third week was 3 1/2%, the fourth week 4 1/2%. The four deliveries made in November were all below 4%. In this garden all bunches were covered at the time of the rain.

(3) INDIAN WELLS AREA—The garden in the Indian Wells area made its first delivery the first week in October with hidden infestation at 9% and the next seven week's deliveries were all above 4% hidden infestation. This garden was not bagged at the time of the rain.

(4) PALM DESERT AREA—The garden in the Palm Desert area made its first delivery in the last week in October. Hidden infestation was 3%. The only week with hidden infestation was the second week in November which was 5%. The bunches in this

garden were covered at the time of the rain.

(5) RANCHO MIRAGE AREA—The garden in the Rancho Mirage area made its first delivery the second week in October with a hidden infestation of 5 1/2%. The following weekly deliveries through November were all below 2%. Investigation showed that all bunches were covered at the time of the rain except a small portion of the garden. Rain damage in this portion was excessive and was picked separately and delivered to the packing house during the second week in October accounting for the high percentage that week. The portion of the garden where the bunches were covered prior to the rain showed a very low percentage of hidden infestation.

One indication from this study was that the covers on the untreated bunches greatly reduced the hidden infestation. After we divided the Valley into these areas we found that the time picking started would have been a better indicator rather than the physical location of the garden. The chart shows that the greater percentage of build up in the earlier ripening periods, the longer it continues to be a problem even after the average temperature falls below that most favorable to the insect.

PERCENTAGES OF INFESTATION IN THE VARIOUS GROWING AREAS OF THE VALLEY

Month Week	September				November				October			
	4	1	2		3	4	1	2	3	4		
Area 1	7%	12%	9%		6%	9%	5%	4%				
Area 2	2%	4 1/2%	5%		3 1/2%	4 1/2%	3%	1%	4%	2%		
Area 3		9%	6%		5%	5 1/2%	5%	6 1/2%	4 1/2%	5 1/2%		
Area 4						3%	3%	4 1/2%	3%	1 1/2%		
Area 5			5 1/2%		1%	0%	2%	0%	0%	1/2%		



EVALUATION OF EFFECTIVENESS OF MALATHION IN THE FIVE PRINCIPAL DATE GROWING DISTRICTS OF THE COACHELLA VALLEY

By E. E. Smith
Valley Date Gardens

For purposes of this study we have divided the Valley into districts, as follows:

1. Oasis District
2. High School District
3. Indio District
4. Indian Wells District
5. Rancho Mirage District

Let me first point out, as you no doubt well know, that the past season was one in which infestation reached a very high point in some areas. The problem was not generally uniform but rather seemed of a somewhat spotty nature. It cannot be denied that some gardens with no dusting were relatively free from infestation, while others with the prescribed treatment showed some infestation particularly in the early picks; thus pointing out the spottiness of the condition in the growing areas.

One of the difficulties in pre-determining the time of application is the unpredictable ripening time. If beetles are present in the garden before the application of the Malathion and some ripening has occurred before dusting, it is possible that infestation may take place in some fruit prior to treatment.

This of course cannot be corrected but evidence supports the theory that those present are killed and that early picks show some infestation which diminishes as succeeding picks are made.

Incidence of infestation seems to be directly connected with the following conditions:

1. Condition of garden as related to debris and rank growth therein.
2. Age and height of palms.
3. Location of garden as related to surrounding gardens and their conditions.

There is no doubt that an unkept garden which is covered by old leaves and bunch debris, which has been removed but not cut up, together with uncultivated weed growth, will create a condition favorable to beetle incubation and growth.

It would appear that there is some basis for the belief that tall palms

are not as susceptible as short ones and a garden which is surrounded by others of an unkept nature, must fight infestation not only from his own but his neighbor's hatch.

In citing instances of effectiveness of Malathion in the five areas of the Valley, I would refer you to our study as reported in last year's institute in which the two adjoining ranches were of much the same age, height, and general condition. Both were interplanted.

Ranch "A" was dusted in the prescribed manner. Ranch "B" was not dusted until after the first pick and then not in the prescribed manner but very lightly. Ranch "A" had no problem remaining within the tolerance while "B" had difficulty most of the season.

During the past season, Ranch "A" was again dusted in the prescribed manner, except that ripening was somewhat advanced at the time of dusting, and as a result some infestation was again present in early picks but cleared up in later picks. Grower "A" thus was able to pick 270,000 pounds of useable fruit from his 30 acres.

Grower "B" dusted after the first pick and again very lightly. As a result this grower marketed only 53,000 pounds from his 30 acres.

The above was in the Oasis district.

In the High School District the ranch under observation dusted according to directions on both Deglets and Medjhools except for a control of Medjhools which were in an area enclosed for hogs and which were not dusted. Both Deglets and Medjhools which were dusted were well within the allowable tolerance but the undusted Medjhools were a total loss due to presence of beetles in large numbers.

In the Indio District, two ranches were observed. They were about one-half mile apart. Ranch "A" was dusted as prescribed and while it was surrounded on all sides by other gardens, it produced dates which were no problem as far as infestation was concerned. Ranch "B" was rela-

tively isolated. No dust was used and the crop was finally sold as culls because of the high infestation.

In the Indian Wells District the Gardens observed were owned by the same person. Here one garden was extremely tall while the other was relatively low. The tall palms were dusted by conventional power duster and was relatively free of infestation while the low garden was dusted with hand equipment and the results were not as good. While the fruit was within the tolerance allowable, it was considerably higher than the tall palms. There is reason to believe that the low palms were not dusted soon enough as first picks showed a higher count than succeeding ones.

In the Rancho Mirage District two ranches were observed. Ranch "A" was composed of palms which were relatively tall. Conventional power equipment was used and infestation was very low.

Ranch "B" was composed of quite low palms. The same type of equipment was used as on Ranch "A," but it was noted that even after the first application there seemed to be a very heavy population of beetles moving about the garden. As a result the owner saw fit to dust the second time and during this second dusting he applied a cover of dust to the ground as well as the palms. Little trouble was experienced by the grower by infestation.

In summary, it is evident that the time of first application is of extreme importance. Last year's crop ripened unusually early and there is definite evidence that in most cases the dusting was not carried out soon enough and as a result the early picks showed indication of infestation to varying degrees. It appears, that to obtain a good control, the gardens should be watched very closely and at the first sign of ripening a preliminary dusting should be applied and that should be followed by another dusting either three weeks before picking or immediately after the first pick depending on varying conditions.

REPORT ON ACTIVITIES OF DATE PACKERS COUNCIL

By Ray Rummonds

Grower and Packer

The Date Packers Council of California got its start in May of 1953. Its first purpose was to attempt to foster better relationships among packers. In the early stages of our meetings the various problems of the industry were discussed and suggestions were made for possible remedies. As a result of these meetings we organized as the Date Packers Council of California in January of 1954. By-laws were adopted. George Berkey was elected President of the organization, Ed Smith Vice-President and Don Rogerson Secy.-Treas.

An assessment of one dollar per 100,000 pounds of dates handled was made for membership. One of our first acts was to donate \$200 to the Indio Chamber of Commerce for the promotion of California Date Week. This was later proclaimed by the Governor.

In February of 1954 one of the council members was charged with mislabeling of dates by the Food and Drug Dept. The charge being that the dates had been processed and were not so marked. The Council took the position that the industry as a whole no longer distinguished between processed and unprocessed fruit since moisture is added to dry fruit and removed from moist fruit only for the purpose of adjusting the moisture content of the dates. Mr. Jarvis and myself appeared before a hearing officer in Los Angeles, presented samples of dates and our reason for not so identifying dates as to natural or processed. As a result of our appearance as a body representing the industry the charges were dropped.

In March of 1954 a suggestion was made that the industry concentrate on an advertising promotion program. An advertising committee was appointed with John Glass as chairman.

In March it was also suggested that the Council reorganize as a non-profit Corporation. Steps were taken to accomplish this and in May of 1954 the Council was reorganized with

myself as President, James E. Wright Vice-President and Ed Smith Secy.-Treas.

In June the heads of the various service organizations in the valley were invited to meet with us. We endeavored to acquaint them with the aims and purposes of the Council and some of the many problems facing the industry.

The advertising committee at this time also recommended that the Council retain the California Foods Research Institute to promote California Dates through the home economics sections of newspapers, magazines, radio, television and schools. The cost to be \$7500 to be raised by an assessment of \$4.00 per 100,000 pounds of dates handled. As a result of this program the industry has received in newspaper and magazines a total of \$300,000 worth of space if figured on current advertising rates.

In July of 1954 it was brought to the council's attention that an attempt was being made to lower the duty on imported dates. The Council contacted our legal advisor Mr. John Babbage and briefs were prepared in opposition to this move. Mr. Wright, Mr. Jarvis and Mr. Babbage went to Washington and appeared before the tariff commissioner and as a result the duty was not changed.

While in Washington Mr. Graham of the U. S. D. A. was contacted by the Council representatives and our problems discussed.

In August Mr. Graham was a guest of the Council in Indio and assured us the U. S. D. A. would, with our cooperation, do anything reasonable to help us. As a result of this visit, Mr. Genske of the U. S. D. A. in Washington was sent to Indio in September to survey the industry and suggest ways and means to work out our problems.

After Mr. Genske's return to Washington we received word from him that with our approval he would submit a proposal to the U. S. D. A.

for price support on a diversion pool. The Council approved his plan and the program was put through. Several of the packers have since availed themselves of this program.

A committee was appointed at that time to study a possible Federal marketing order for dates.

In October a proposal was received from Nelson McNinch to aid the Date Industry by having a "holiday for Dates" Program for one week to originate from Indio. The Council advanced \$500 as a token of our appreciation to KNX and as you know these programs originated from Indio in November and the Industry received many thousands of dollars worth of free advertising.

In November the Council also asked the U. S. D. A. to revise its existing grade standards for dates and also ask the state of California to revise and raise the State Standardization Standards for dates. At the present time we are assured that these changes will be made in time for the 1955-1956 crop year.

In January of 1955 Mr. Genske returned from Washington and the Council working with him drew up the first rough draft of a proposed Federal Marketing order which was sent to Washington for review. It was returned to the Council in February for review and the Council upon reviewing it sent a formal request to Washington for a public hearing on the proposed marketing order. The request for the hearing was approved and the hearing set for March 23-24. As you know there was no opposition to the Marketing Order at the hearing. The report on the testimony taken is now in Washington for approval.

The Packers Council feels that it is at last on the road to Industry Cooperation and if we can get the support of all the growers behind their individual packers we hope to put the industry back on a firm and profitable basis.

Date Growers' Institute - 1955 Membership

Anderson, Lee Coachella
Arkell Date Garden Indio

Bisbee, Melvin-Hall, Hass & Vessey, Thermal
Blackburn, R. W. Thermal
Breyer, Alberto Argentina
Brown, Thomas R. Thermal

California Date Growers Assn. Indio
Carpenter, John Indio
Carreon, Dr. R. J., Jr. Indio
Cast, E. Langdon Mecca
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Indio Chamber of Commerce Indio

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Jenkins, Paul Indio
Jenkins, W. G. Indio
Johnson, Mrs. May Bard

Kral, Louis Calexico

Laflin, Ben, Jr. Thermal
Laflin, Ben, Sr. Thermal
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Lindgren, David L. Riverside

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Page, Milton C.—Rancho Palm Springs, Indio
Patterson, Kenneth K. Indio
Pinyan, R. A. Indio
Reuther, Walter Gainesville, Florida
Richardson, H. B. Davis
Richardson, W. L. Porterville
Riverside Co. Agricultural Com. Riverside
Russel, Robbins Redlands
Rygg, G. L. Pomona

Scheniman Paper Co. Indio
Schwabacher, A. E. San Francisco
Shields Date Garden Indio
Sphinx Date Garden Phoenix, Arizona
Stogsdill, R. D.—Smith Lithograph Co.
. Los Angeles

Sunipalms Date Garden Indio
Swingle, Leonhardt Indio
Swingle, Mrs. W. T. Washington, D. C.

Turk, Howard Coachella

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Vincent, Lloyd E. Riverside

Warner, A. L. D. Indio
Webb, Robert W., Jr. Palm Desert
Westerfield, John Coachella
Western Province Fruit Research Station
. Stellenbosch, South Africa

Wilson, Gwynn Arcadia
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Woodbury, George Indio

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